

AP[®] BIOLOGY
2011 SCORING GUIDELINES (Form B)

Question 4

Phylogeny reflects the evolutionary history of organisms.

- a.** **Explain** THREE methods that have been used to investigate the phylogeny of organisms. **Describe** a strength or weakness of each method.
(6 points maximum)

Response earns 1 point for each method explained and 1 point for either a strength *OR* a weakness.

Methods (1 point)	AND Strengths (1 point)	OR Weaknesses (1 point)
Fossils (paleontology)	Determine time; reveal extinct species.	Not all species leave fossils. Fossil record is incomplete.
Anatomy/morphology	Homologous structures indicate evolutionary relationships.	Analogous structures. Some taxa have little diversity (e.g., bacteria). Some morphology reflects environment or diet.
Embryology/development	Reveals similarities in structures and patterns of development that are not evident in adults.	Similarities between species may be lost in later development.
Molecular traits (amino acid sequence in proteins or base sequence in DNA)	Large numbers of traits. Allow study of evolution between closely related species. Most accurate.	No (or little) data for extinct species. Variation within species blurs differences between species.
Behavioral traits	Some behaviors are genetic (e.g., frog calls).	Behavior maybe culturally transmitted or learned (e.g., bird calls).

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Question 4 (continued)

DATA ON PRESENCE
OF SPECIFIC DNA SEQUENCES

Locus	1	2	3	4	5	6	7	8	9	10	11	12	13
Cow	–	–	–	–	–	+	+	+	+	+	+	+	–
Deer	–	–	–	–	–	+	?	+	+	+	+	+	–
Whale	+	+	+	+	+	–	?	+	+	–	?	+	–
Hippo	?	–	+	+	+	–	+	+	+	–	?	+	–
Pig	–	–	?	–	–	–	?	–	?	–	–	+	+
Peccary	?	?	?	?	?	?	?	?	?	?	?	?	+
Camel	–	–	–	–	–	–	–	–	–	–	–	–	–

+ sequence present – sequence absent ? undetermined

b.

- For each tree, **describe** a monophyletic group, the closest relative to the whale, and the point at which the pulley astragalus was lost or gained.
(3 points maximum)
 - Correctly identifying a monophyletic group in *BOTH* Tree I and II (a number of correct possibilities) or correctly defining a monophyletic group as a species and all of its descendants. **(1 point)**
 - Correctly identifying the camel as the closest relative to the whale in Tree I *AND* the hippo in Tree II. **(1 point)**
 - Stating that the gain of the pulley astragalus bone in Tree I occurs between the whale and the camel, *OR* that the loss of the bone occurs on the line to whales, *AND* that the loss of the pulley astragalus bone in Tree II occurs between the common ancestor of the hippo and the whale. **(1 point)**
- Based on the principle of parsimony (the simplest explanation is the best) and the genomic information in the table shown, **identify** which tree is the best representation of the evolutionary relationship of these animals, and **justify** your answer.
(1 point maximum)

Identification of correct tree	Justifications include but are not limited to
Tree II	<ul style="list-style-type: none"> The camel is the out-group, with none of the 13 sequences. The peccary and pig have the fewest sequences, but they are similar. The deer and cow share the same half of the 13 sequences. The whale and hippo have a similar pattern of DNA sequences.

Note: No point is earned for using the pulley astragalus bone to justify Tree II, nor for discussing common environments, body shapes, or feeding habits.